

What is claimed is:

- 1 1. An electro-mechanical energy conversion system to selectively convert and
2 transfer energy from an input energy source to an output energy load
3 comprising an energy converter device coupled between the input energy
4 source and the output energy load to convert the energy from the input
5 energy source and to transfer the converted energy to the output energy load
6 and an energy conversion and transfer control to selectively control the
7 energy converted from the input energy source and transferred to the output
8 energy load in response to a plurality of predetermined conditions or
9 parameters wherein the energy converter device comprises an energy
10 converter section including a permanent magnet machine having a rotor and
11 stator to selectively convert the energy from the input energy source and to
12 selectively transfer the converted energy to the output energy load and an
13 energy transfer section including a plurality of stator control elements coupled
14 to said stator and a plurality of control elements to said load of said
15 permanent magnet machine, said plurality of stator control elements and said
16 plurality of said rotor control elements operatively coupled by a resonant
17 transfer link to selectively transfer energy between said stator and the load to
18 control the operation of said permanent magnet machine and wherein said
19 energy conversion and transfer control comprises an energy converter control
20 to control the operation of said energy converter device and a source/load
21 control to control the operation of said input energy source and output energy
22 load with respect to said energy converter device.

- 1 2. The electro-mechanical energy conversion system of Claim 1 wherein said
2 plurality of stator control elements and said plurality of rotor control elements
3 are symmetrical.
- 1 3. The electro-mechanical energy conversion system of Claim 2 wherein each
2 said stator energy transfer control element comprises a switch coupled to
3 each phase of said stator of said permanent magnet machine.
- 1 4. The electro-mechanical energy conversion system of Claim 3 wherein the
2 input and output switches are programmed to operate as a charge pump to
3 provide the high switch sample rates (time repetitive duration) to transfer
4 charge at high power and high frequency and to charge pump sequence to
5 provide the required input to output voltage gain at the reduced PMG rotation
6 rates.
- 1 5. The electro-mechanical energy conversion system of Claim 3 wherein the
2 input switches from each phase is energized in a timed pattern so that the
3 phase AC input is processed by charge transfer directly to a corresponding
4 phase output thereby eliminating the rectification and DC link required with
5 PWM conversion.
- 1 6. The electro-mechanical energy conversion system of Claim 3 wherein the
2 input and the desired charge transfer conditions to perform soft-start and
3 rapid shut-down of current flow.

- 1 7. The electro-mechanical energy conversion system of Claim 3 wherein the
2 series resonant link provides electrical isolation at above and below the
3 resonant link resonating frequency and whereby the control of the input
4 switches and output switches are driven with a timing pattern and sequence
5 to provide the volt-amps reactance to the three phase load during the fault
6 disturbance.
- 1 8. The electro-mechanical energy conversion system of Claim 1 wherein said
2 resonant transfer link is bi-directional.
- 1 9. The electro-mechanical energy conversion system of Claim 1 further includes
2 an isolation element is coupled between said plurality of stator control
3 elements and said plurality of rotor control elements.
- 1 10. The electro-mechanical energy conversion system of Claim 9 wherein said
2 isolation element comprises a transformer.
- 1 11. The electro-mechanical energy conversion system of Claim 8 wherein the
2 energy transfer device further includes a stator ground energy transfer control
3 element and a second ground energy transfer control element coupled to
4 ground on either side of said bi-directional resonant transfer link.
- 1 12. The electro-mechanical energy conversion system of Claim 11 wherein the
2 four input switches are time sequenced is a timing pattern to allow each
3 phase of the generator to supply sinusoidal current at the desired generator

4 power factor and sequencing the output switch to supply sinusoidal current at
5 the power factor requested by the AC grid.

1 13. The electro-mechanical energy conversion system of Claim 1 wherein the
2 voltage for each said stator energy transfer control element and each said
3 output phase is interrogated to determine whether or not power for phases on
4 said stator and for phases on said output are within a predetermined range of
5 the predetermined reference level.

1 14. The electro-mechanical energy conversion system of Claim 13 wherein when
2 the initial charge V_{CS} is greater than the output voltage E_O , the input voltage
3 E_I is connected to the output voltage E_O .

1 15. The electro-mechanical energy conversion system of Claim 13 wherein with
2 the correct polarity across said resonant capacitor when the V_{CF} is less than a
3 predetermined multiple of E_{MAX} and V_{CS} is less than a predetermined multiple
4 of E_O and the sum of E_I and V_C is less than E_O , the poled input phase E_I is
5 connected to G_O to increase the charge on the resonant capacitor.

1 16. The electro-mechanical energy conversion system of Claim 13 wherein when
2 the correct polarity across said resonant capacitor when the V_{CF} is greater
3 than a predetermined multiple of E_{MAX} or the V_{CF} is greater than a
4 predetermined multiple of E_O , the poled output phase E_O is connected to G_I to
5 discharge.

1 17. The electro-mechanical energy conversion system of Claim 13 wherein when
2 the initial charge V_{CS} is greater than the output voltage E_O , the input voltage
3 E_I is connected to the output voltage E_O ; with the correct polarity across the
4 resonant capacitor and when the V_{CF} is less than a predetermined multiple of
5 E_{MAX} and V_{CS} is less than a predetermined multiple of E_O and the sum of E_I and
6 V_{CS} is less than E_O , the poled input phase E_I is connected to G_O to increase the
7 charge on the resonant capacitor; and when the correct polarity across said
8 resonant capacitor when the V_{CF} is greater than a predetermined multiple of
9 E_{MAX} or the V_{CS} is greater than a predetermined multiple of E_O , the poled
10 output phase E_O is connected to G_I to discharge.

1 18. The electro-mechanical energy conversion system of Claim 13 wherein, after
2 the selected energy transfer, the final voltage on the resonant capacitor V_{CF} is
3 less than a predetermined multiple of E_{MAX} and V_{CS} is less than a
4 predetermined multiple of E_O and the sum of E_I and V_{CS} is less than E_O , the
5 poled input E_I is connected to G_O to increase the charge on the resonant
6 capacitor; and when the correct polarity across said resonant capacitor is
7 correct when the V_{CF} is greater than a predetermined multiple of E_{MAX} or the
8 V_{CS} is greater than a predetermined multiple of E_O , the poled output phase E_O
9 is connected to G_I to discharge.